GEOTHERMAL RESOURCE DEVELOPMENTS
State of Hawaii

Circular C-100

State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Water and Land Development

Honolulu, Hawaii
March 1984

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Governor

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PREFACE

The Geothermal Resources Development report was prepared to assist in the designation of geothermal resource subzones in the State of Hawaii as mandated by Act 296, SLH 1983, and contains a compilation of currently available information relating to geothermal development in Hawaii.

This report identifies the existing exploratory well sites, and outlines the current geothermal resource mining leases issued by the State Board of Land and Natural Resources. Also included is a list of geothermal exploratory drilling permits issued by the Department of Land and Natural Resources and special use permits issued by the County of Hawaii and the State Land Use Commission.

In order to demonstrate the feasibility of geothermal energy utilization, a brief outline of the HGP-A Well head Generator Project has been included. This information along with future contributions to the Department will be of valuable assistance in determining the location and quality of Hawaii's geothermal resources.

This publication was prepared by Dean Nakano, Geologist, with assistance from Edwin Sakoda, Geologist, and Neal Imada, Civil Engineer.

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ILLUSTRATIONS

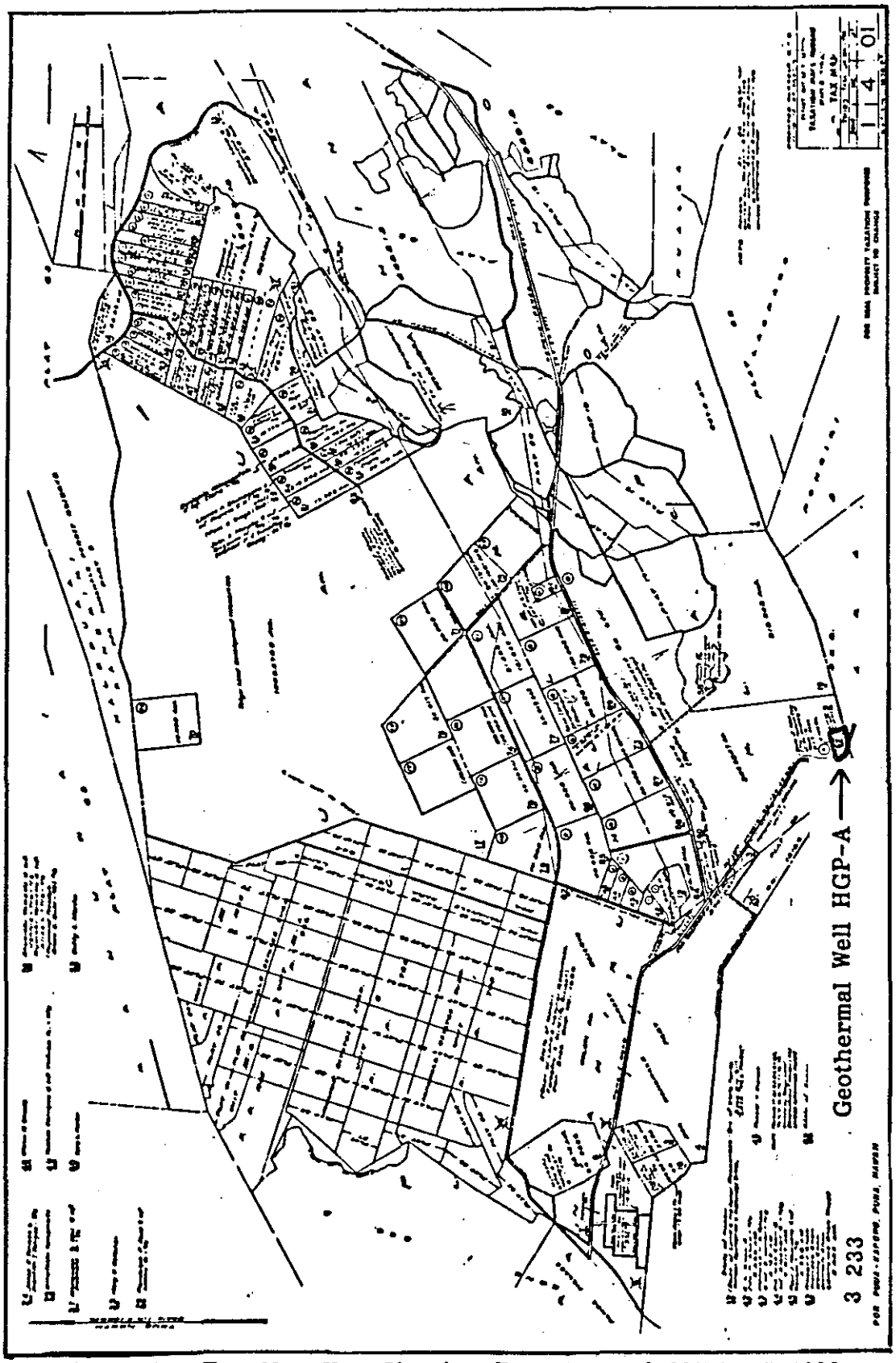

Figure 1. Tax Map Key Showing Boundary of GMRL, S-4602.

GEOTHERMAL RESOURCE MINING LEASES (GRML)

(1) Geothermal Resource Mining Lease: S-4602 (HGP-A) (1955 Flow)

Issued To: The Research Corporation of the University of Hawaii

Location: Kapoho, Puna, Hawaii

TMK: 1-4-01: Portion of 2 (currently indicated as parcel 82)

Area: 4.1 acres

Land Ownership: State of Hawaii

Effective Date: June 19, 1979

Term: 10 years primary, 35 years maximum

General Information:

- Well Drilled to Date: HGP-A
- Leased Area Zoned: Agriculture
- Mineral rights reserved to State of Hawaii
- See Figure 1

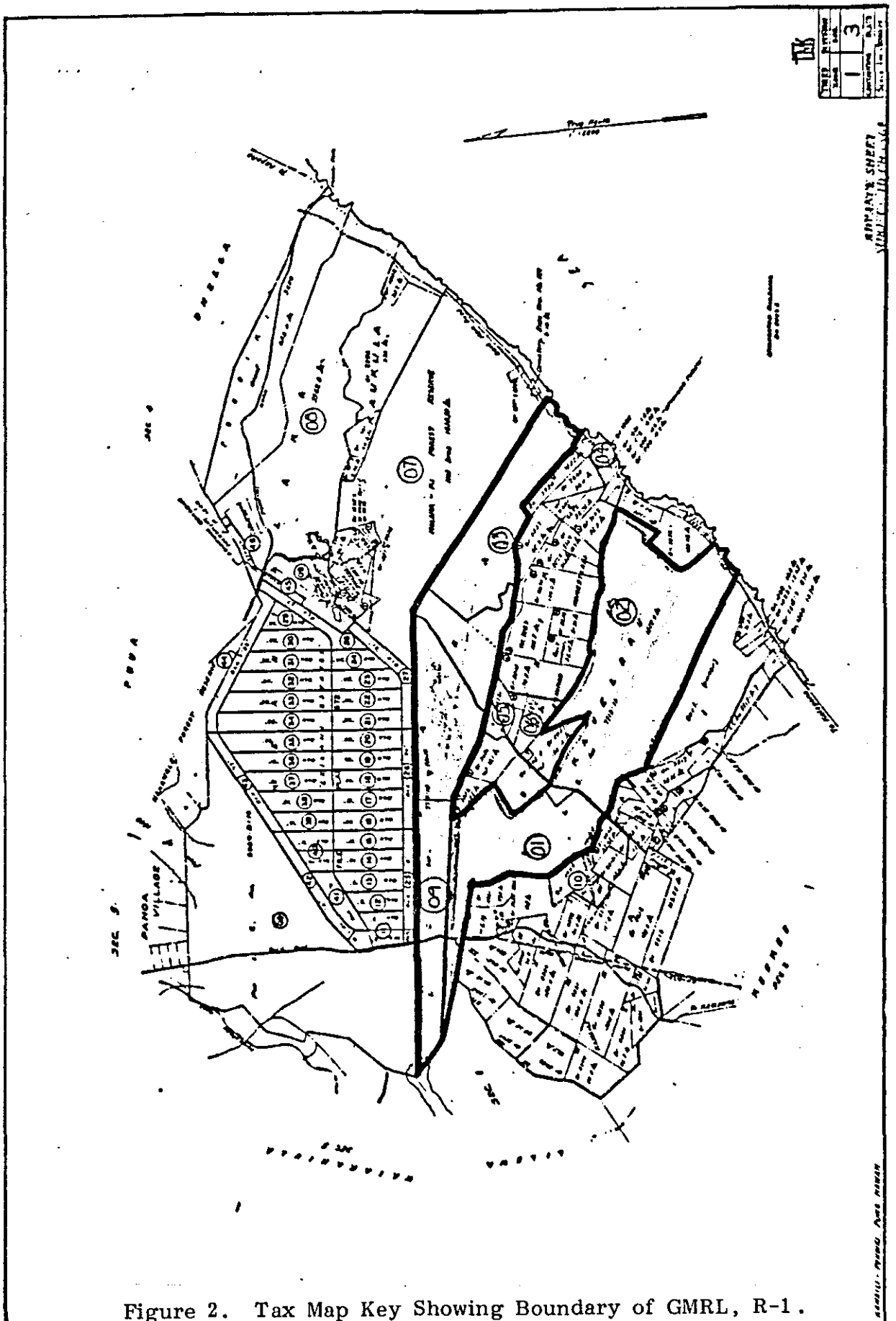

Figure 2. Tax Map Key Showing Boundary of GMRL, R-1.

(2) Geothermal Resource Mining Lease: R-1 (SEE KAMAILI SECTION)

Issued To: Bishop Estate, Subleased to Puna Geothermal Venture (Thermal Power, Dillingham, Amfac)

Location: Puna, Hawaii

TMK: 1-3-01: 22, 23, 58, 59
1-3-02: 32, 33, 59, 79-84, 87
1-3-03: 5, 6, 41
1-3-09: 1, 2, 5, 8, 10

Area: 3,486.73 acres

Land Ownership: Bishop Estate

Effective Date: March 1, 1981

Term: 10 years primary, 65 years maximum

General Information:

- No exploratory drilling to date
- Portion of leased area zoned conservation (TMK: 1-3-09: Portion of 5), balance of area zoned agriculture
- Mineral rights reserved to State of Hawaii, subject to verification by Division of Land Management
- See Figure 2

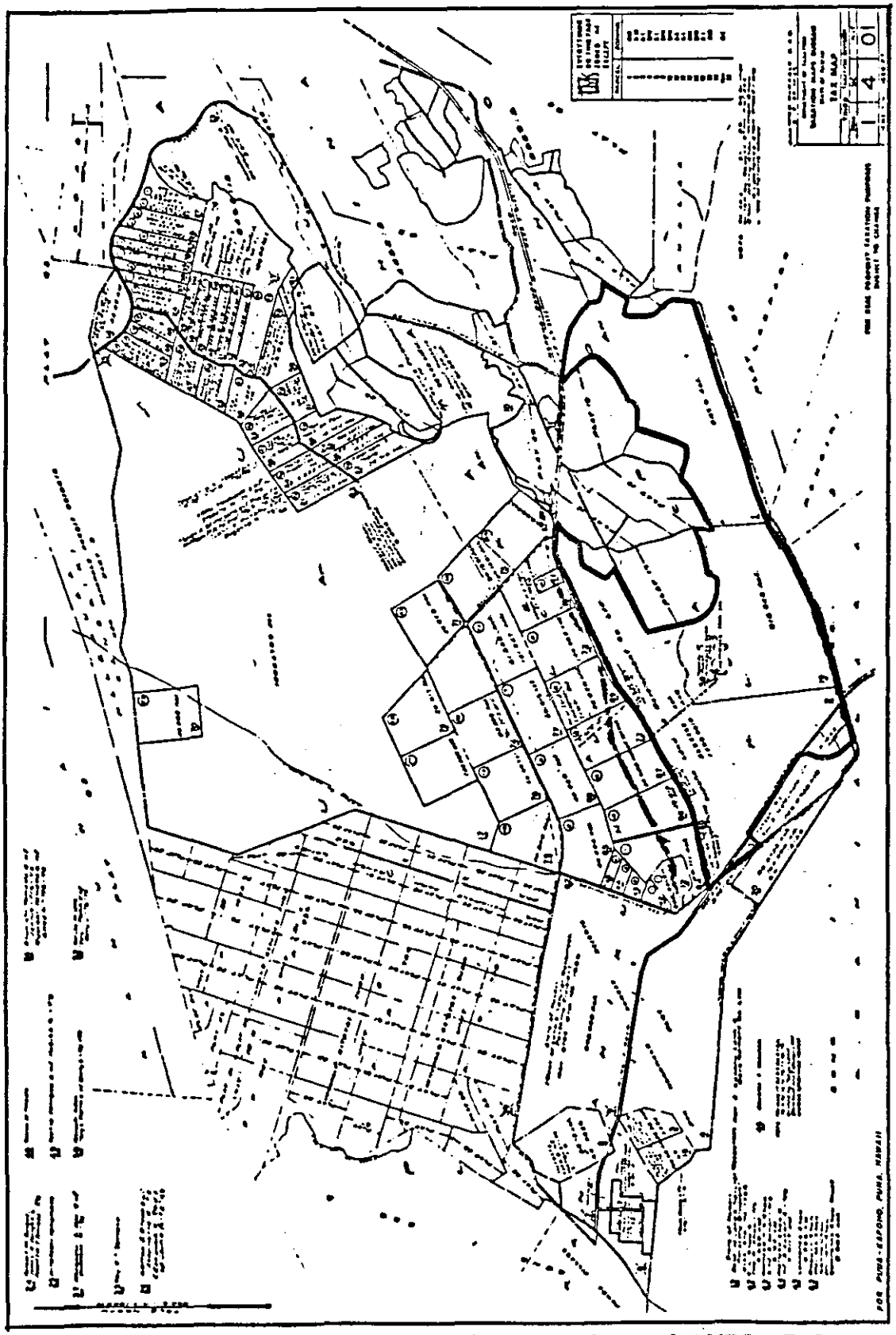

Figure 3. Tax Map Key Showing Boundary of GMRL, R-2.

(3) Geothermal Resource Mining Lease: R-2 (KAPOHO SECTION)

Issued To: Kapoho Land Partnership, Subleased to Puna Geothermal Venture (Thermal Power, Dillingham, Amfac)

Location: Kapoho, Puna, Hawaii

TMK: 1-4-01: 1, 2, ~~Portion of~~ 3, 19, 58 (1-4-01: 80 NOT CONTAINED IN LEASE R-2)

Area: 815.799 acres

Land Ownership: Kapoho Land and Development Co., Ltd.

Effective Date: March 1, 1981

Term: 10 years primary, 65 years maximum

General Information:

- Wells Drilled to Date: Kapoho State No. 1 / K-S. No. 1A
  Kapoho State No. 2
- Leased Area Zoned: Agriculture
- Mineral rights reserved to State of Hawaii, subject to verification by Division of Land Management
- See Figure 3

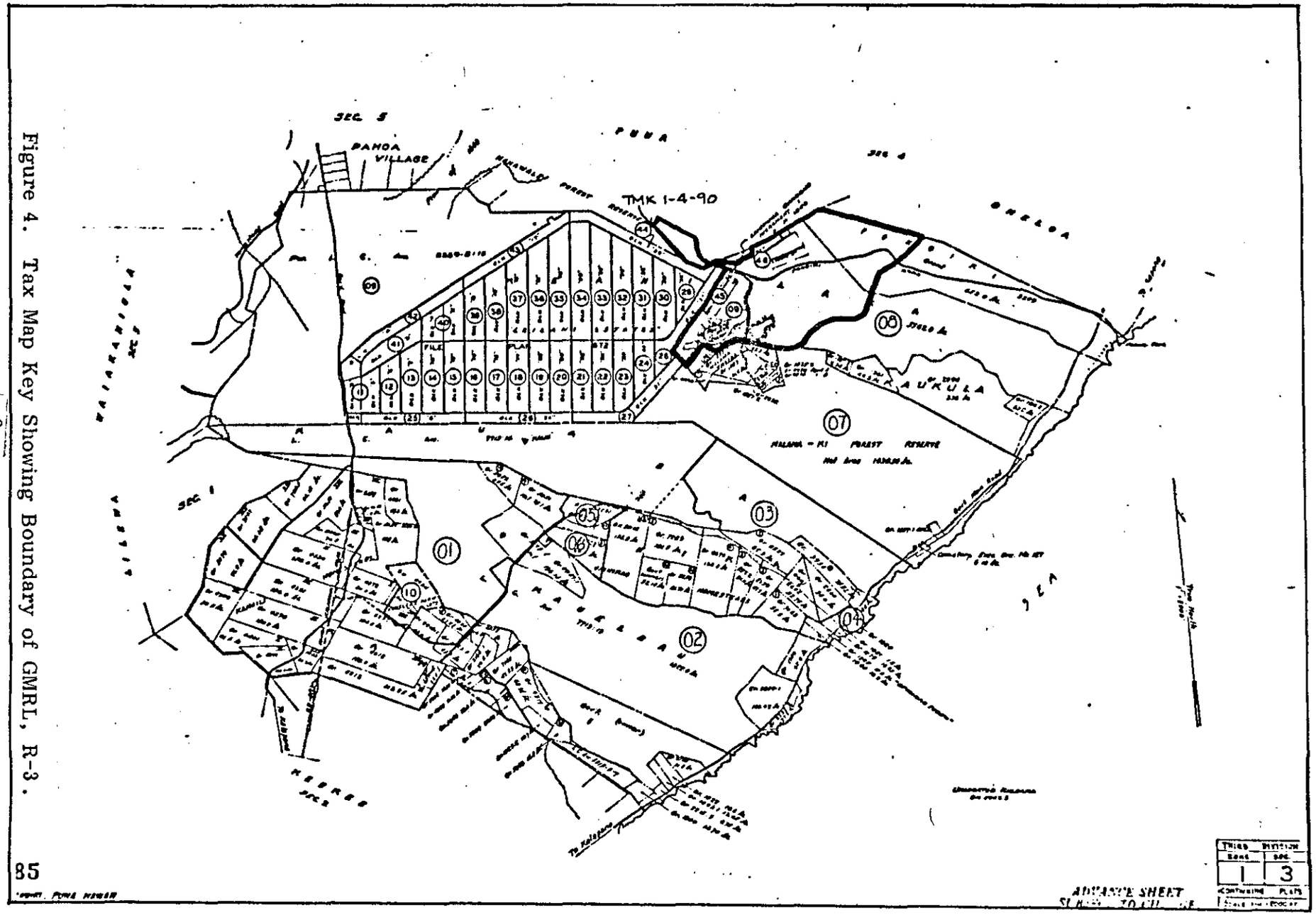

Figure 4. Tax Map Key Showing Boundary of GMRL, R-3.

(4) Geothermal Resource Mining Lease: R-3 (KAPOHO SECTION)

Issued To: Barnwell Geothermal Corp.

Location: Pohoiki, Puna, Hawaii

TMK: 1-3-45: 9, 10, 14, 16-18, 21, 22, 25
1-3-46: 2-5, 13-25, 29, 30, 33-74, 76, 78, 79, 81, 82, 84
1-3-08: 6, 7, 19 (currently noted as TMK 1-3-08: 6, **7**, 19, 22-32)
1-3-09: 7 (currently noted as 1-3-45 : 33-39)
1-4-01: Portion of 20 (currently noted as TMK 1-4-90: 1-13, 15, 16, 17, 18-27, 28)

Area: 769.14 acres (777.25 ac.)

Land Ownership: J.T. Trading Co., Ltd. and Auto Imports of Hawaii, Inc.

Effective Date: September 1, 1981

Term: 10 years primary, 65 years maximum

General Information:

- Wells Drilled to Date: Lanipuna No. 1 / LANIPUNA NO. 1 RE-DRILL (DIRECTIONAL)
  Lanipuna No. 6
- Leased Area Zoned: Agriculture
- Mineral Rights: The following parcels, TMK: 1-3-08: 6, 7, 19, have no mineral reservations. All other parcels have mineral rights reserved to State of Hawaii, subject to verification by Division of Land Management.
- See Figure 4

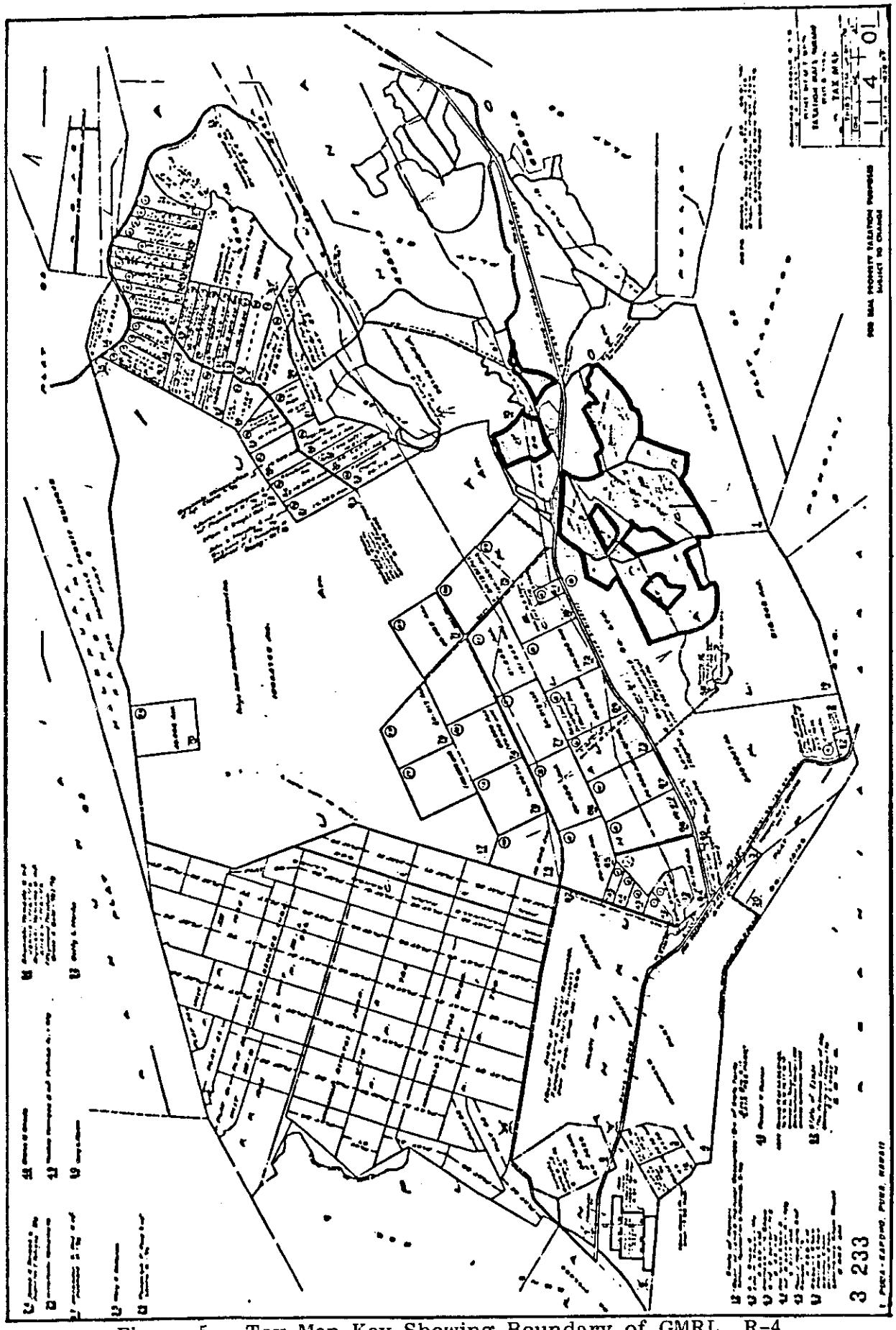

Figure 5. Tax Map Key Showing Boundary of GMRL, R-4.

(5) Geothermal Resource Mining Lease: R-4 (KAPOHO SECTION)

Issued To: Puna Geothermal Venture (Thermal Power Co., Dillingham, Amfac)

Location: Kapoho, Puna, Hawaii

TMK: 1-4-16: 1-3, 5-11, 13
1-4-17: 2, 3, 6-12
1-4-18: 1-5, 7-10, 13
1-4-19: 1-3, 9
1-4-20: 7, 8
1-4-21: 2-4

Area: 279.38 acres

Land Ownership: Various owners who have executed an assignment of their occupier rights to PGV

Effective Date: September 1, 1982 (lease document in preparation)

Term: 10 years primary, 65 years maximum

General Information:

- No exploratory drilling to date
- Leased Area Zoned: Agriculture
- Mineral rights reserved to State of Hawaii, subject to verification by Division of Land Management
- Lease application applies to 279.377 acres out of a total area covering 425.28 acres. The owners of the following parcels declined to enter into leasing agreement:

  TMK: 1-4-16: 3, 4, 7; 1-4-17: 4, 5; 1-4-18: 6, 11; 1-4-19: 4-8, 11, 12; 1-4-20: 1-5; 1-4-21: 1,5-7

- See Figure 5

DRILLING PERMITS ISSUED BY DLNR

Well Name	Permit Date	Status	Operator
FNB No. 2	9/26/78	Expired (9/26/79)	Puuwaawaa Steam Co. (partnership between GEDCO and F. Newell Bohnett)
HGP-A	9/10/79	Completed (in production)	Research Corporation of the University of Hawaii
Ashida No. 1 (Opihikao No. 1)	1/10/80	Expired (1/10/81)	GEDCO
Lanipuna No. 1 LANIPUNA No. 1 RE-DRILL	1/20/81	Expired (9/20/83)	Barnwell Geothermal Corp.
~~Daiichi No. 1~~	~~3/2/81~~	Expired SITE ONLY (3/2/82)	GEDCO
Lanipuna ~~No. 2~~	~~3/4/81~~	Expired (3/4/82)	Barnwell ~~Geother~~mal Corp.
Lanipuna No. 3	3/4/81	Expired (3/4/82)	~~Barnwell Geothermal~~ Corp.
Lanipuna No. 6	11/10/83	In progress (expires 11/10/84)	Barnwell Geothermal Corp.
Kapoho State No. 1 KS No. 1A	3/19/81	Expired (9/14/83)	Puna Geothermal Venture (PGV)
Kapoho State No. 2	1/8/82	Expired (7/7/83)	PGV

SPECIAL USE PERMITS ISSUED BY THE
COUNTY OF HAWAII AND THE STATE LAND USE COMMISSION

Project: Puuwaawaa Steam Co. Area: 143 acres

Permit No.: SP 79-333 (LUC 411) TMK: 7-1-5: 56

Effective Date: 6/1/79 Expiration: 7/1/82

Issued To: Geothermal Exploration and Development Co. (GEDCO)

General Information:

- Landowner: Mr. F. Newell Bohnett
- No mineral reservations or mining lease
- Land Use Zoning: Agriculture

Project: HGP-A Area: 4.1 acres

Permit No.: SP 78-307 (LUC 392) TMK: 1-4-01: Portion of 2 (currently noted as parcel 82)

Effective Date: 2/7/79 Expiration: ongoing

Issued To: Research Corporation of the University of Hawaii

General Information:

- Refer to GRML S-4602

Project: Ashida No. 1 (Opihikao No. 1) Area: 120 acres

Permit No.: SP 77-265 (LUC 364) TMK: 1-3-01: 24, 25

Effective Date: 7/14/77 Expiration: 12/31/87

Issued To: GEDCO

General Information:

- Land Owner: Mr. Harold Ashida and Mr. Vern Yamanaka
- No mineral reservations or mining lease; mineral rights leased to GEDCO.
- Land Use Zoning: Agriculture
- Drilling permit issued for only 49.6 acres (TMK 1-3-01: 24)

Project: Lanipuna (6 wells)

Area: Portion of 769.14 acres (12 acres ±)

Permit No.: SP 471

TMK: 1-3-8: 6, 7, 19
1-3-9: Portion of 7

Effective Date: 12/16/80

Expiration: 12/31/87

Issued To: Barnwell Geothermal Corp.

General Information:

- Refer to GRML R-3

Project: Daiichi No. 1

Area: 180 acres

Permit No.: SP 80-347 (LUC 460)

TMK: 1-4-02: 10

Effective Date: 2/13/81

Expiration: 12/31/87

Issued To: GEDCO

General Information:

- Landowner: Daiichi Seiko of Hawaii, Inc.
- No mineral reservations or mining lease. Mineral rights leased to GEDCO
- Land Use Zoning: Agriculture
- No exploratory drilling; site only

Project: Kapoho State (2 wells)

Area: Portion of 815.99 acres (4 acres ±)

Permit No.: SP 468

TMK: 1-4-01: Portion of 2 and 19

Effective Date: 10/15/80

Expiration: 10/15/86

Issued To: Thermal Power Co. (PGV)

General Information:

- Refer to GRML R-2
- Testing Program underway

Figure 6. Portion of Pahoa South Quadrangle Map Showing Geothermal Well Sites Located in the Puna District.

GEOTHERMAL EXPLORATORY WELLS

Well Name	Status	Driller	Depth Drilled (ft.)
FNB No. 2	Abandoned (converted to water well No. 4850-01)	WRII*	6800
HGP-A	Completed (experimental production)	WRII	6450
Ashida No. 1 (Opihikao No. 1)	Suspended	WRII	8000
Lanipuna No. 1 LANIPUNA No. 1 (RE-DRILL)	Restart/slant drilling 5/10/83	WRII	8000+
Daiichi No. 1	Not drilled	--	7000 (prop.)
Lanipuna No. 2	Not drilled	WRII	7000 (prop.)
Lanipuna No. 3	Not drilled	--	7000 (prop.)
Lanipuna No. 6	Active	WRII	5000 (prop.)
Kapoho State No. 1	Testing	WRII	7290
Kapoho State No. 2	Testing	WRII	8005

*Water Resources International

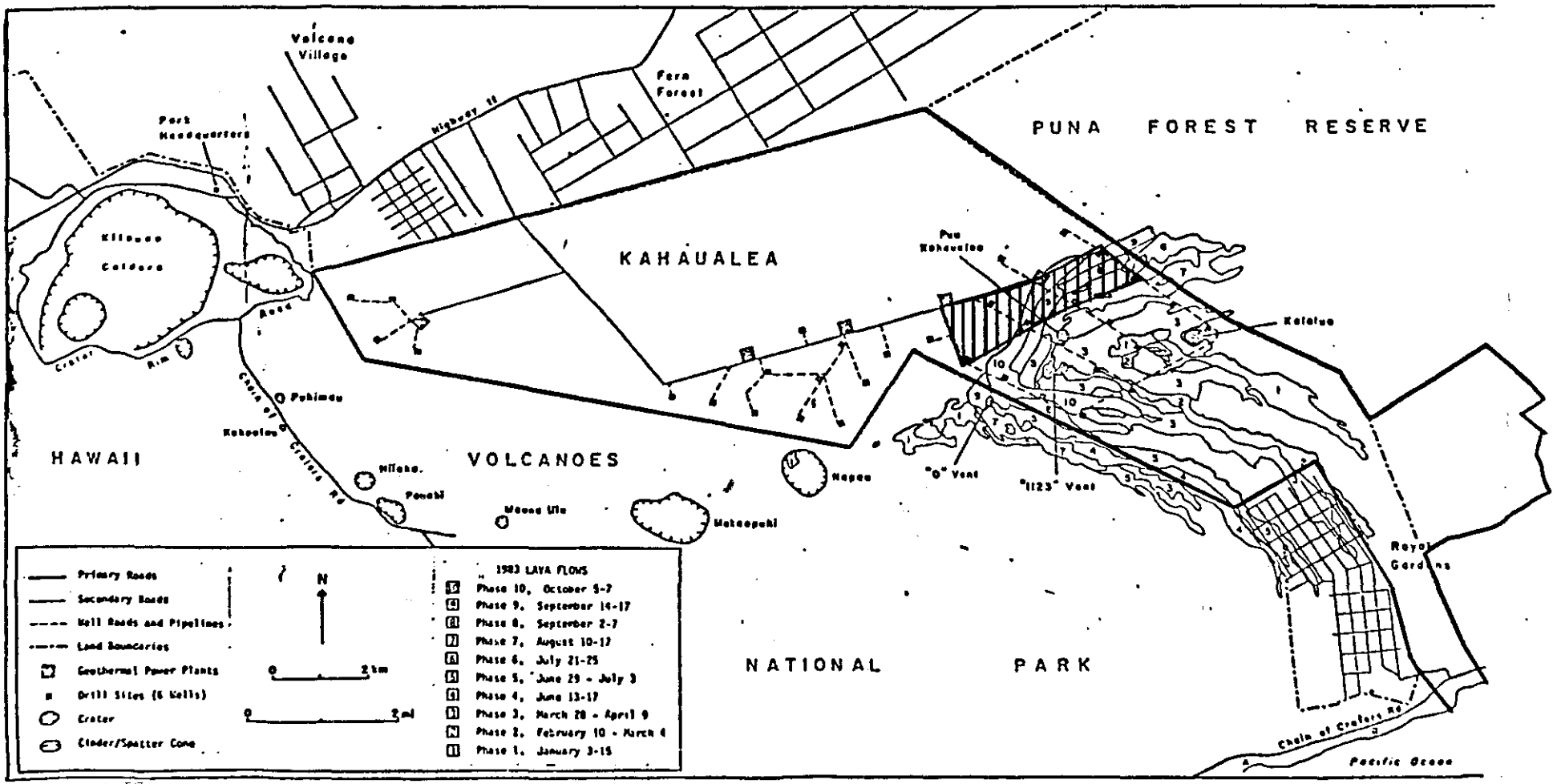

Figure 7. Location Sketch of Proposed Campbell Estate Geothermal Project (Kahaualea) Showing Some of the 1983 Lava Flows.

CAMPBELL ESTATE GEOTHERMAL PROJECT (Kahaualea)

Location: Kahaualea, Puna, Hawaii

TMK: 1-1-01: 1
1-2-08: 1

Area: 25,461.31 acres

Land Ownership: James Campbell Estate

Pending Sublease To: True/Mid-Pacific Geothermal Venture

General Information:

- Geothermal Mining Lease application to include 25,059 acres out of approximately 25,613 acres owned by Campbell Estate.
- Proposed lease area includes both Conservation zoned lands (22,533 acres) and Agriculture zoned lands (2,928 acres).
- Project site bordered on the west and southwest by Volcanoes National Park and on the east by the Puna Forest Reserve.
- Development plans to include access road construction, 5 power plant sites, and up to 35 miltiple well drilling sites of approxiately 3 to 5 acres each, assuming it is possible to conduct directional drilling of up to 6 wells per site.
- On February 25, 1983, the State Board of Land and Natural Resources granted conditional approval of a Conservation District Use Permit to Campbell Estate. The Board's decision allows Campbell Estate to drill up to 8 exploratory wells within a restricted area of the Conservation district or cease exploration when 4 wells show indication of geothermal resource potential.
- The Board set forth conditional requirements to study air quality, meteorological data and noise monitoring to provide the public with safeguards on geothermal emissions.
- Campbell Estate has not applied to the Board of Land and Natural Resources for a mining lease or drilling permit to date.
- Volcanic eruptions have occurred throughout 1983 to present and lava flows have since covered lands within the approved designated area.
- The Board is scheduled to conduct a supplementary hearing for the limited purpose of obtaining data aobut the effect of these lava flows on Campbell Estates' exploratory drilling plans.

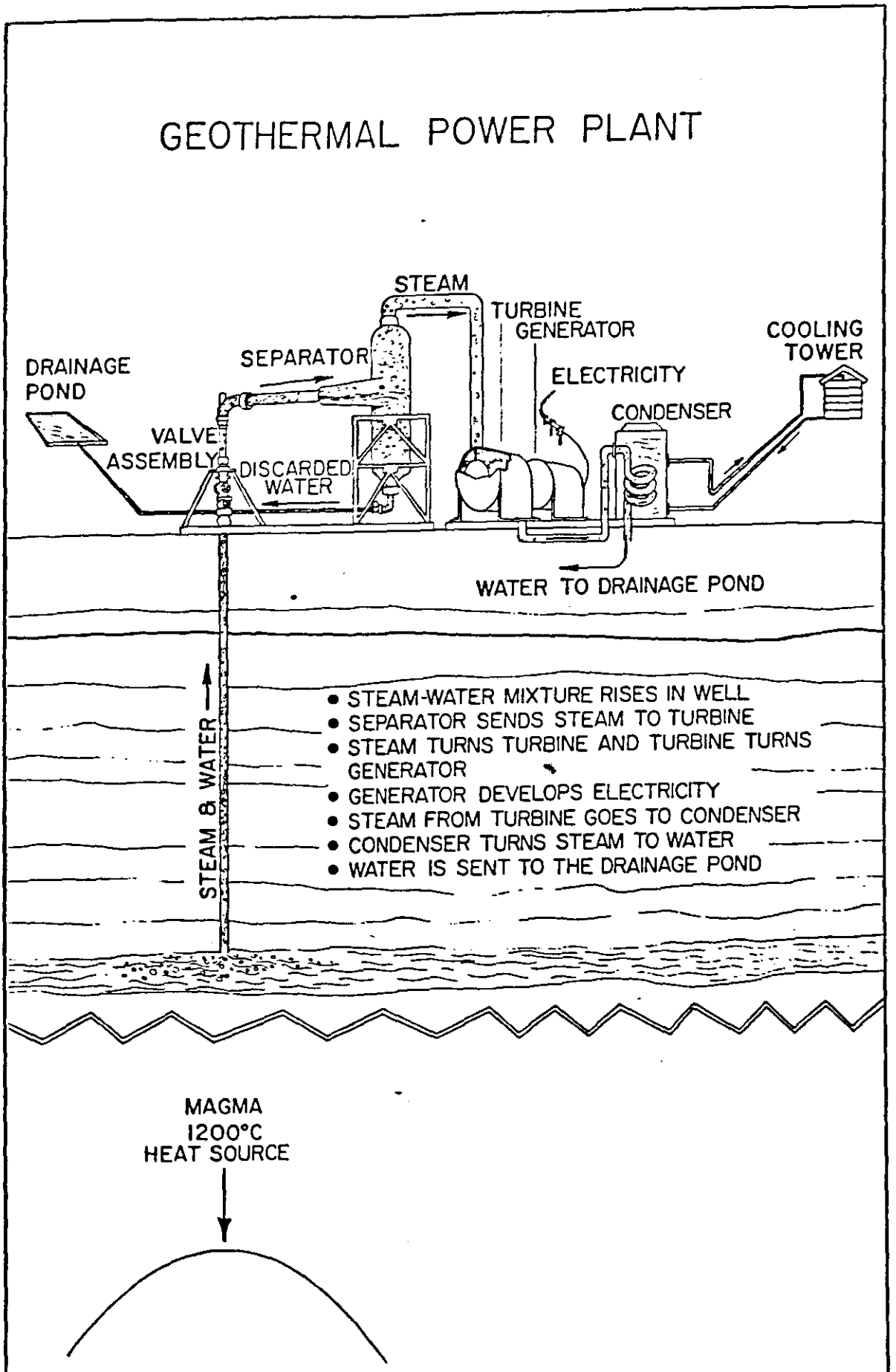

Figure 8. Geothermal Power Plant Diagram.

GEOTHERMAL ENERGY PRODUCTION (HGP-A)

Project: HGP-A Well head Generator Project

Project Funding: U.S. Department of Energy
State of Hawaii
County of Hawaii
Hawaii Electric Light Co. (HELCO)

Design Consultants: Rogers Engineering Co, Inc. of San Francisco
W.A. Hirai and Associates, Inc. of Hilo

Project Management: Research Corporation of the University of Hawaii (RCUH) for the HGP-A Development Group

Facility Operation: HELCO personnel to provide daily routine maintenance and operated remotely from HELCO's control room in Hilo.

Power Plant Design:

Generator electrical output of 3 megawatts (3,000 Kilowatts) based on steamflow rate of 60,000 lb/hr at 160 psig and 350°F. 2.8 megawatts appropriated for HELCO distribution to approximately 2,500 residents in the Puna district.

Well head assembly and specific equipment designed for protection or easy removal to avoid lava flows.

Installation of environmental controls to limit air, water and noise pollution.

Major Plant Components:

Steam Supply System consisting of wellhead, steam flash cyclone separator to separate steam and water phases, and additional in line separator to remove residual liquids.

Turbine-Generator producing 3.0 megawatts of electricity of which 0.2 megawatts allotted for plant auxiliary equipment.

Hydrogen Sulfide Abatement using a caustic soda system for removal of H_2S and other non-condensable gases that are extracted and burned in an incineration system.

Condenser where exhausted steam from the turbine is separated into liquid and non-condensable gases. Part of this condensate is used to replenish the cooling water lost by evaporation.

Cooling Water System where heat is absorbed through a closed water system and dissipated into the atmosphere by evaporative cooling. The process occurs when warm water is sprayed down the cooling tower and is contacted by cool air flowing through the water.

Silica Settling Pond where excess condensate water is combined with the liquid from the separator and travels to a concrete retention pond where silica is deposited and water is then percolated into the ground.

Production Data:

Production of enough electricity to displace 40,000 barrels of crude oil annually (approximately $1.6 million based on 1980 prices). Electricity sold to HELCO and revenue received to offset operating and maintenance costs.

Monthly operating figures received from RCUH outline amounts of geothermal fluids and electricity produced from HGP-A in addition to the gross revenue and calculations of the waived royalties pursuant to geothermal mining lease No. S-4602.

Summary:

Geothermal energy has demonstrated to be one of the more economical and one of the least polluting of all current fuels used for electrical production. If commercialized it would greatly reduce the millions of dollars spent annually for imported fuel.

Also, lower temperature steam development although not directly valuable for electricity production can be used for direct heat application in agriculture and aquaculture.

Geothermal energy production is a feasible alternative to fossil fuels and nuclear energy to supply HELCO's projected demand of an additional 25 megawatts by 1988.

SUMMARY OF MONTHLY HGP-A OPERATING FIGURES

Month/Year	Steam (1000 lbs)	Brine (1000 lbs)	Net KWH Generated	Gross Revenue	Royalty*
Jun. 12-30, 1981	24,260	24,250			
Jul. 1-31, 1981	40,920	40,920	124,600	$ 498	$ 50
Aug. 1-31, 1981	39,430	42,780			
Sep. 1-4, 1981	4,590	5,130			
Dec. 11-31, 1981	25,300	42,850	--	--	--
Jan. 1982	37,940	49,990	116,600	466	47
Feb. 1982	34,270	41,930	227,400	910	91
Mar. 1982	37,940	45,350	866,000	46,738	4,674
Apr. 1982	36,720	43,890	1,440,000	77,717	7,772
May 1982	38,390	49,100	1,788,100	96,504	9,650
Jun. 1982	37,150	47,520	1,744,000	94,124	9,412
Jul. 1982	38,390	49,104	1,790,000	96,612	9,661
Aug. 1982	38,390	49,104	1,257,900	67,889	6,789
Sep. 1982	37,152	47,520	1,800,000	97,146	9,715
Oct. 1982	38,390	49,104	1,869,700	100,908	10,091
Dec. 1982	38,390	49,104	1,840,700	99,343	9,934
Jan. 1983	38,390	49,100	1,887,100	101,677	10,168
Feb. 1983	34,675	44,348	1,570,400	84,613	8,461
Mar. 1983	38,390	49,104	1,903,600	102,566	10,257
Apr. 1983	34,550	44,200	1,713,400	92,318	9,232
May 1983	39,090	50,000	1,890,000	101,833	10,183
Jun. 1983	26,250	33,580	1,269,200	68,385	6,838
Sep. 1983	33,252	42,530	1,607,700	86,623	8,662
Oct. 1983	22,800	29,200	1,104,500	59,510	5,951

*Waived by the BLNR (6/19/79)

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